Exercises for Section 7.1

4. A stress analysis was conducted on random samples of epoxy-bonded joints from two species of wood. A random sample of 120 joints from species A had a mean shear stress of 1250 psi and a standard deviation of 350 psi, and a random sample of 90 joints from species B had a mean shear stress of 1400 psi and a standard deviation of 250 psi. Find a 98% confidence interval for the difference in mean shear stress between the two species.

8. The article “Occurrence and Distribution of Ammonium in Iowa Groundwater” (K. Schilling, Water Environment Research, 2002:177–186) describes measurements of ammonium concentrations (in mg/L) at a large number of wells in the state of Iowa. These included 349 alluvial wells and 143 quaternary wells. The concentrations at the alluvial wells averaged 0.27 with a standard deviation of 0.40, and those at the quaternary wells averaged 1.62 with a standard deviation of 1.70. Find a 95% confidence interval for the difference in mean concentrations between alluvial and quaternary wells.

12. In an experiment involving high-temperature performance of two types of transistors, a sample of 60 transistors of type A were tested and were found to have a mean lifetime of 1427 hours and a standard deviation of 183 hours. A sample of 180 transistors of type B were tested and were found to have a mean lifetime of 1358 hours and a standard deviation of 240 hours. Can you conclude that the mean lifetimes differ between the two types of transistors?

16. In a study of the relationship of the shape of a tablet to its dissolution time, 36 disk-shaped ibuprofen tablets and 48 oval-shaped ibuprofen tablets were dissolved in water. The dissolution times for the disk-shaped tablets averaged 258 seconds with a standard deviation of 12 seconds, and the times for the oval-shaped tablets averaged 262 seconds with a standard deviation of 15 seconds. Can you conclude that the mean dissolve times differ between the two shapes?

Exercises for Section 7.2

2. The article “Accidents on Suburban Highways-Tennessee’s Experience” (R. Margiotta and A. Chatterjee, Journal of Transportation Engineering, 1995:255–261) compares rates of traffic accidents at intersections with raised medians with rates at intersections with two-way left-turn lanes. Out of 4644 accidents at intersections with raised medians, 2280 were rear-end accidents, and out of 4584 accidents at two-way left-turn lanes, 1982 were rear-end accidents. Assuming these to be random samples of accidents from two types of intersections, find a 90% confidence interval for the difference between the proportions of accidents that are of the rear-end type at the two types of intersections.

6. The article “Case Study Based Instruction of DOE and SPC” (J. Brady and T. Allen, The American Statistician, 2002:312–315) describes an effort by an engineering team to reduce the defect rate in the manufacture of a certain printed circuit board. The team decided to reconfigure the transistor heat sink. A total of 1500 boards were produced the week before the reconfiguration was implemented, and 345 of these were defective. A total of 1500 boards were produced the week after reconfiguration, and 195 of these were defective. Find a 95% confidence interval for the decrease in the defective rate after the reconfiguration.

10. Resistors labeled as 100Ω are purchased from two different vendors. The specification for this type of resistor is that its actual resistance be within 5% of its labeled resistance. In a sample of 180 resistors from vendor A, 150 of them met the specification. In a sample of 270 resistors purchased from vendor B, 233 of them met the specification. Vendor A is the current supplier, but if the data demonstrate convincingly that a greater proportion of the resistors from vendor B meet the specification, a change will be made.
   a. State the appropriate null and alternate hypotheses.
   b. Find the P-value.
   c. Should a change be made?

14. Out of 1200 pieces of gravel from one plant, 110 pieces are classified as “large.” Out of 900 pieces from another plant, 95 are classified as large. Can you conclude that there is a difference between the proportions of large gravel pieces produced at the two plants?

Exercises for Section 7.3
4. An experiment was performed in a manufacturing plant by making 5 batches of a chemical using the standard method (A) and 5 batches using a new method (B). The yields, expressed as a percent of a theoretical maximum, were as follows:
Method A: 77.0 69.1 71.5 73.0 73.7
Method B: 78.5 79.6 76.1 76.0 78.5
Find a 99% confidence interval for the difference in the mean yield between the two methods.

8. In the article “Bactericidal Properties of Flat Surfaces and Nanoparticles Derivatized with Alkylated Polyethylenimines” (J. Lin, S. Qiu, et al., Biotechnology Progress, 2002:1082–1086), experiments were described in which alkylated polyethylenimines were attached to surfaces and to nanoparticles to make them bactericidal. In one series of experiments, the bactericidal efficiency against the bacterium E. coli was compared for a methylated versus a nonmethylated polymer. The mean percentage of bacterial cells killed with the methylated polymer was 95 with a standard deviation of 1, and the mean percentage of bacterial cells killed with the nonmethylated polymer was 70 with a standard deviation of 6. Assume that five independent measurements were made on each type of polymer. Find a 95% confidence interval for the increase in bactericidal efficiency of the methylated polymer.

12. Eight independent measurements were taken of the dissolution rate of a certain chemical at a temperature of 0°C, and seven independent measurements were taken of the rate at a temperature of 10°C. The results are as follows:

\begin{tabular}{|c|c|c|}
\hline
Truck & Hot & Cold \\
\hline
1 & 4.56 & 4.26 \\
2 & 4.46 & 4.08 \\
3 & 6.49 & 5.83 \\
4 & 5.37 & 4.96 \\
5 & 6.25 & 5.87 \\
6 & 5.90 & 5.32 \\
7 & 4.12 & 3.92 \\
8 & 3.85 & 3.69 \\
9 & 4.15 & 3.74 \\
10 & 4.69 & 4.19 \\
\hline
\end{tabular}

Can you conclude that the dissolution rates differ between the two temperatures?

16. The article “Time Series Analysis for Construction Productivity Experiments” (T. Abdelhamid and J. Everett, Journal of Construction Engineering and Management, 1999:87–95) presents a study comparing the effectiveness of a video system that allows a crane operator to see the lifting point while operating the crane with the old system in which the operator relies on hand signals from a tagman. A lift of moderate difficulty was performed several times, both with the new video system and with the old tagman system. The time (in seconds) required to perform each lift was recorded. The following table presents the means, standard deviations, and sample sizes.

\begin{tabular}{|c|c|c|}
\hline
 & Mean & Std. Deviation & Sample size \\
\hline
Tagman & 69.33 & 6.26 & 12 \\
Video & 58.50 & 5.59 & 24 \\
\hline
\end{tabular}

Can you conclude that the mean time to perform a lift is less when using the video system than when using the tagman system? Explain.

Exercises for Section 7.4

4. A sample of 10 diesel trucks were run both hot and cold to estimate the difference in fuel economy. The results, in mpg, are presented in the following table. (From “In-use Emissions from Heavy-Duty Diesel Vehicles,” J. Yanowitz, Ph.D. thesis, Colorado School of Mines, 2001.)

\begin{tabular}{|c|c|c|}
\hline
Truck & Hot & Cold \\
\hline
1 & 2.86 & 2.59 \\
2 & 2.85 & 2.47 \\
3 & 1.84 & 1.58 \\
4 & 1.60 & 1.56 \\
5 & 0.80 & 0.78 \\
6 & 0.89 & 0.66 \\
7 & 2.03 & 1.87 \\
8 & 1.90 & 1.71 \\
\hline
\end{tabular}

Find a 98% confidence interval for the difference in mean fuel mileage between hot and cold engines.

6. The article “Effect of Refrigeration on the Potassium Bitartrate Stability and Composition of Italian Wines” (A. Versari, D. Barbanti, et al., Italian Journal of Food Science, 2002:45–52) reports a study in which eight types of white wine had their tartaric acid concentration (in g/L) measured both before and after a cold stabilization process. The results are presented in the following table.

\begin{tabular}{|c|c|c|}
\hline
Wine Type & Before & After & Difference \\
\hline
1 & 2.86 & 2.59 & 0.27 \\
2 & 2.85 & 2.47 & 0.38 \\
3 & 1.84 & 1.58 & 0.26 \\
4 & 1.60 & 1.56 & 0.04 \\
5 & 0.80 & 0.78 & 0.02 \\
6 & 0.89 & 0.66 & 0.23 \\
7 & 2.03 & 1.87 & 0.16 \\
8 & 1.90 & 1.71 & 0.19 \\
\hline
\end{tabular}

Find a 95% confidence interval for the mean difference between the tartaric acid concentrations before and after the cold stabilization process.
10. The article “Modeling of Urban Area Stop-and-Go Traffic Noise” (P. Pamanikabud and C. Tharasawatipipat, Journal of Transportation Engineering, 1999:152–159) presents measurements of traffic noise, in dBA, from 10 locations in Bangkok, Thailand. Measurements, presented in the following table, were made at each location, in both the acceleration and deceleration lanes.

<table>
<thead>
<tr>
<th>Location</th>
<th>Acceleration</th>
<th>Deceleration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>78.1</td>
<td>78.6</td>
</tr>
<tr>
<td>2</td>
<td>78.1</td>
<td>80.0</td>
</tr>
<tr>
<td>3</td>
<td>79.6</td>
<td>79.3</td>
</tr>
<tr>
<td>4</td>
<td>81.0</td>
<td>79.1</td>
</tr>
<tr>
<td>5</td>
<td>78.7</td>
<td>78.2</td>
</tr>
<tr>
<td>6</td>
<td>78.1</td>
<td>78.0</td>
</tr>
<tr>
<td>7</td>
<td>78.6</td>
<td>78.6</td>
</tr>
<tr>
<td>8</td>
<td>78.5</td>
<td>78.8</td>
</tr>
<tr>
<td>9</td>
<td>78.4</td>
<td>78.0</td>
</tr>
<tr>
<td>10</td>
<td>79.6</td>
<td>78.4</td>
</tr>
</tbody>
</table>

Can you conclude that there is a difference in the mean noise levels between acceleration and deceleration lanes?

14. For a sample of nine automobiles, the mileage (in 1000s of miles) at which the original front brake pads were worn to 10% of their original thickness was measured, as was the mileage at which the original rear brake pads were worn to 10% of their original thickness. The results are given in the following table.

<table>
<thead>
<tr>
<th>Automobile</th>
<th>Front</th>
<th>Rear</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>32.8</td>
<td>41.2</td>
</tr>
<tr>
<td>2</td>
<td>26.6</td>
<td>35.2</td>
</tr>
<tr>
<td>3</td>
<td>35.6</td>
<td>46.1</td>
</tr>
<tr>
<td>4</td>
<td>36.4</td>
<td>46.0</td>
</tr>
<tr>
<td>5</td>
<td>29.2</td>
<td>39.9</td>
</tr>
<tr>
<td>6</td>
<td>40.9</td>
<td>51.7</td>
</tr>
<tr>
<td>7</td>
<td>40.9</td>
<td>51.6</td>
</tr>
<tr>
<td>8</td>
<td>34.8</td>
<td>46.1</td>
</tr>
<tr>
<td>9</td>
<td>36.6</td>
<td>47.3</td>
</tr>
</tbody>
</table>

a. Can you conclude that the mean lifetime of rear brake pads is greater than that of front brake pads?
b. Can you conclude that the mean lifetime of rear brake pads exceeds that of front brake pads by more than 10,000 miles?

**Exercises for Section 7.5**

4. A broth used to manufacture a pharmaceutical product has its sugar content, in mg/mL, measured several times on each of three successive days.